GANNETS IN NORTH AMERICA: PRESENT NUMBERS AND RECENT POPULATION CHANGES

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Gannets (*Morus bassanus*) are common in spring, summer, and fall on the Atlantic coast of Canada. While their present breeding sites have long been known, existing data on populations and history are fragmentary and incomplete, as these colonies are in generally remote and inaccessible areas (Fig. 1). However, the sparse information on populations is sufficient to indicate that Gannet numbers and distribution have fluctuated considerably during the period of historical record, views which have been extensively documented and published (Bent 1922, Fisher and Vevers 1943, 1944, Fisher and Lockley 1954, Palmer 1962). It is my purpose to present here the results of 1972 and 1973 surveys of 6 North American gannetries and briefly review and summarize other recent census data.

CENSUS METHODS

Procedures used to census North American Gannet colonies in the past have varied widely, ranging from simple visual impressions of bird numbers to ground counts of nests. In some cases, such as at Funk Island, methods used to count breeding pairs have been reasonably consistent since the early 1950's as they were performed largely by the same investigator (Dr. L. M. Tuck). Most counts at other colonies, however, were not performed by the same observer in different years nor were similar census techniques always used. Clearly this variation in census reliability and accuracy has made it very difficult, if not impossible, to make precise comparisons of population numbers either within or between colonies. To avoid similar difficulties in the collection and interpretation of data in the future, it seemed evident that a standardized census method was required, one which would be sufficiently rigid to reduce individual observer bias to a minimum and provide a permanent and precise record of the distribution and numbers of nesting birds at individual colonies. Consequently, I developed a technique of population analysis from aerial photography, similar to those used to count Gannets elsewhere (Salmon and Lockley 1933, Barrett and Harris 1965).

The method used at each colony in 1972 and 1973 was basically the same. A series of over-lapping aerial photographs was taken during the incubation period in June or July (see Tables 1 and 2 for details) from a light fixed-wing aircraft using either a 35 mm (Baccalieu Island), 70 mm (Anticosti Island, Bird Rocks, Bonaventure Island, Cape St. Mary's), or K-24 aerial reconnaissance camera (Funk Island) with standard lenses (135 mm, 100 mm, 177 mm, respectively) and Kodak Plus-X or Double-X black and white film. The usual distance from the colony was about 550–610 m, although Funk Island was photographed at a vertical overhead distance of about 1220 m.

The disturbance of nesting birds by the aircraft was slight, and no movement from nest territories was detected. Nesting areas were easily delimited on the photos

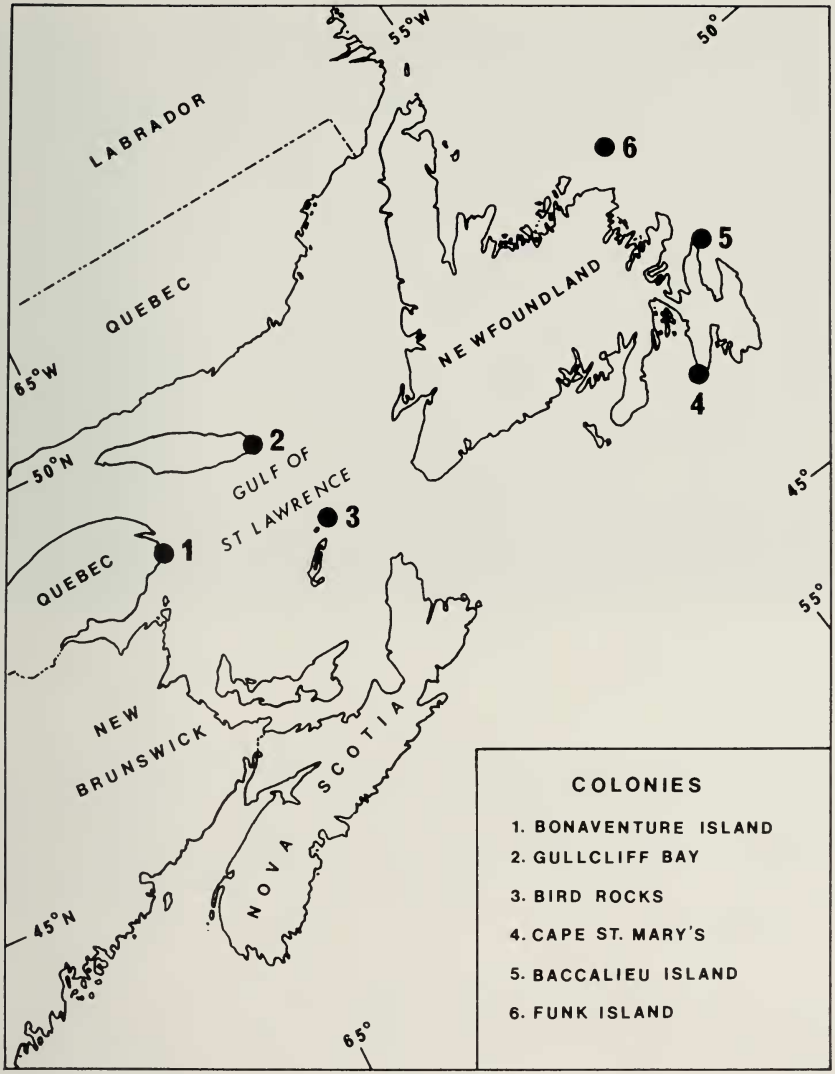

FIG. 1. Approximate locations of Gannet colonies in North America.

(18 × 25 cm or 23 × 32 cm glossy enlargements) by the extremely regular spacing of white dots (see Barrett and Harris 1965). Individual attended nests were counted under a hand lens (8×) using a plastic grid overlay (1 cm × 1 cm quadrats) and following procedures similar to those outlined by Barrett and Harris (1965). Photo quality not only allowed individual nests to be counted, but often made it possible to determine whether 1 or 2 birds were associated with each nest. The single source of

FIG. 2. Aerial view of a portion of the Gannet colony on Bonaventure Island, Quebec, 7 July 1973, showing the 2 principal nesting habitats: cliff ledges and flattish ground above the cliff top.

error is in the demarcation of nesting areas on the prints, but this has been estimated by Barrett and Harris (1965) to be less than 2%. Since only attended nests were counted, and the status of each nest was unknown, this assessment of breeding population represents the number of "nest-site holders" rather than the number of "true breeders" (i.e., pairs that built a nest and laid 1 egg). Number estimates given in the tables and text are those actually calculated even though their "exactness" may be a bit spurious.

DESCRIPTION OF COLONIES

Bonaventure Island, Quebec.—Bonaventure Island, at 48°30′N × 64°09′W, is approximately 2.7 km long and 2.6 km broad at its widest point and is roughly circular in shape with an area of about 460 ha. The cliffs are made up of a conglomerate-red sandstone mixture that reaches a height of 91 m on the southeastern coast where the Gannets nest (Fig. 2).

Gullcliff Bay, Anticosti Island, Quebec.—Anticosti Island, at 49°09′N × 61°42′W, is situated in the western entrance to the Gulf of St. Lawrence and measures 225 km long and 48 km wide. The Gannet colony on the southeastern tip of the island in Gullcliff Bay, consists of several small nesting groups (2 to 37 pairs per group) scattered along about 1.69 km of highly fractured and crumbly 46–61 m high cliffs (Fig. 3).

FIG. 3. Aerial view of a portion of the Gannet colony in Gullcliff Bay, Anticosti Island, Quebec, 12 June 1972.

Bird Rocks, Magdalen Islands, Quebec.—The Bird Rocks, at 47°50′N × 61°09′W, are the northernmost islands of the Magdalen Islands Archipelago in the Gulf of St. Lawrence. There are 2 islands in the Bird Rocks group, Great Bird and North Bird (= Little Bird), both of which have nesting Gannets. Great Bird is somewhat circular in shape (0.4 km diameter) with a grassy-turf top and 30 m precipitous limestone cliffs on which the Gannets nest; North Bird, immediately northwest of Great Bird, is much smaller and highly eroded (Fig. 4).

Cape St. Mary's, Newfoundland.—Cape St. Mary's, at 46°50′N × 54°12′W, is the southwestern extremity of the Avalon Peninsula. It appears as a high tableland when viewed from a distance. The Gannet colony is on Bird Rock, a large 152 m high rock stack, only slightly separated from the adjacent mainland cliffs (Fig. 5). Nests cover the seaward-facing, sloped, cliff face from about 30 to 46 m above the sea to the top of the stack.

Baccalieu Island, Newfoundland.—Baccalieu Island, at 48°07′N × 52°47′W, is situated at the northeast tip of the Avalon Peninsula, about 2.4 km eastward of Split Point. It is about 6.1 km long and 1.3 km broad at its widest point and runs north-south along the greater dimension. The gannets nest on high, almost inaccessible, precipitous rock cliffs towards the mid-point of the east, seaward-facing coast (Fig. 6).

Funk Island, Newfoundland.—Funk Island, at 49°46′N × 53°11′W, is a flat-topped oblong granite rock situated about 56 km north-northeast of the east coast of Newfoundland (Cape Freels). It is 0.8 km long, 0.4 km wide, and approximately 14 m high at its highest point. The Gannet colony is towards the west end of the island on level ground, ringed by breeding murres, principally *Uria aalge* (Fig. 7).

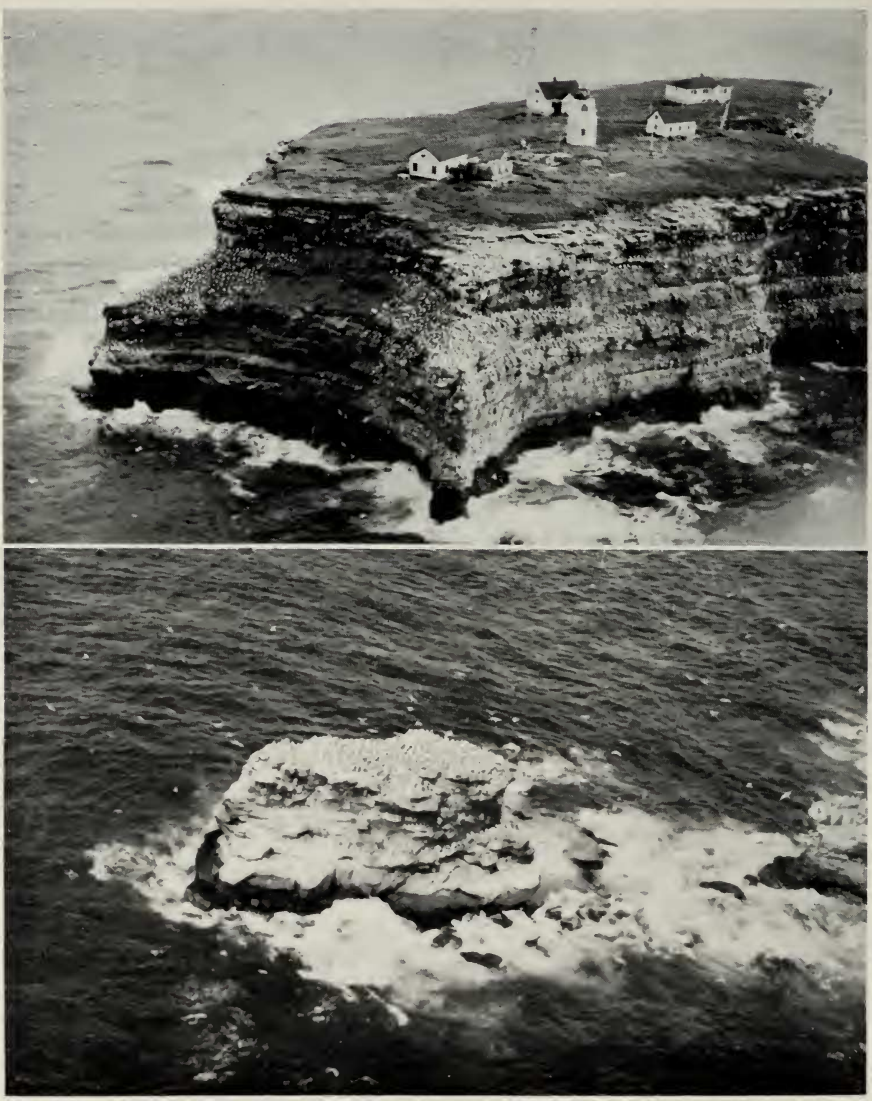

FIG. 4. Aerial view of the Bird Rocks: Great Bird (above) and North Bird (below), Magdalen Islands, Quebec, 7 July 1973.

RESULTS AND DISCUSSION

Present Breeding Population Size

The results of the 1972 and 1973 censuses are summarized in Table 1. On the basis of my surveys, I estimate that there were 32,731 pairs of Gan-

FIG. 5. Aerial view of Bird Rock, Cape St. Mary's, Newfoundland, 18 June 1972.

nets breeding in eastern North America. Of this total, 22,747 pairs (69.5%) nest in the Gulf of St. Lawrence and 9984 pairs (30.5%) on the Atlantic coast of Newfoundland.

Recent Population Changes

Data from counts made before 1972 at the various colonies are fragmentary and often incomplete. In general, though they lack the standardization necessary to allow precise comparisons of population estimates, they appear adequate to detect major numerical changes and population trends, especially in the Gulf of St. Lawrence where photography has been used to estimate numbers of breeding pairs since 1961. Table 2 summarizes the estimates of population sizes at the 6 colonies between 1959 and 1973.

Bonaventure Island, Quebec.—It appears that the breeding population peaked close to 1966, followed by an abrupt decline of roughly 16% between 1969 and 1973. While the difference between the 1966 and 1969 estimates may be due to different methods of counting and estimating the colony, the decrease in numbers from 20,511 pairs in 1969 to 17,281

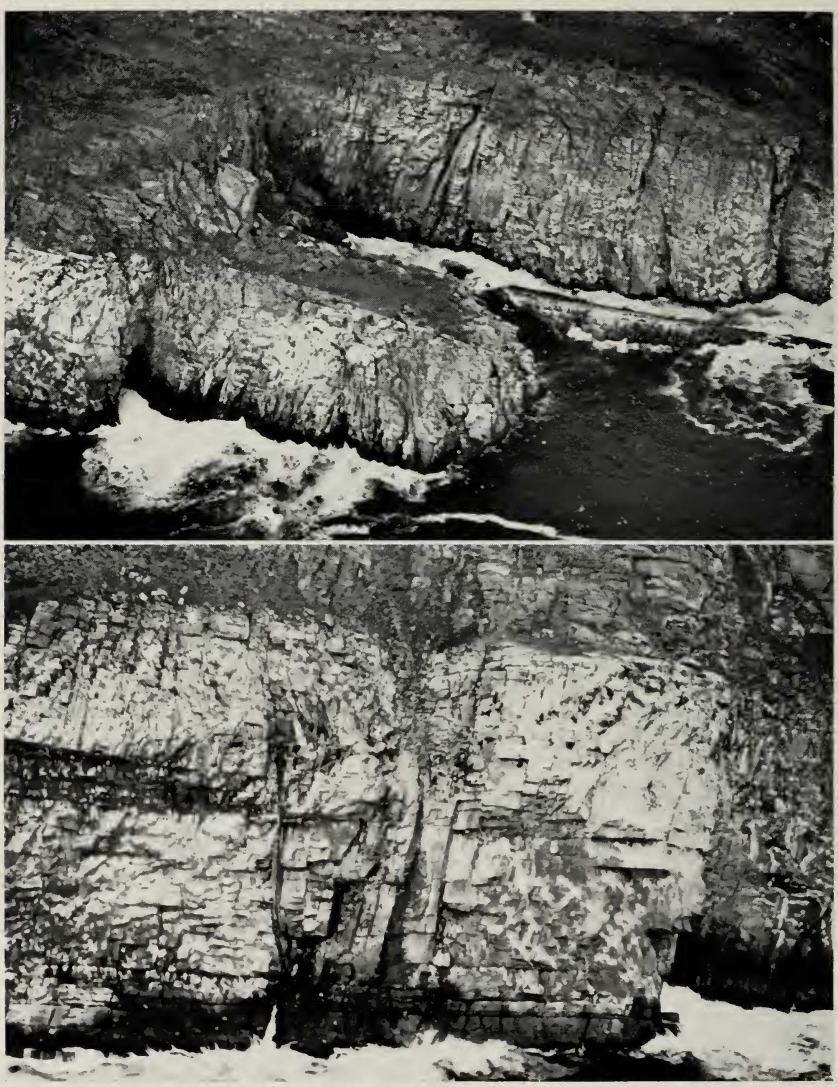

FIG. 6. Aerial views of the Gannet colony on Baccalieu Island, Newfoundland, 21 June 1973: most of the colony (above) and a close-up of a portion of the cliffs (below).

pairs in 1973 appears to be real as the census procedures and method of analysis were virtually identical.

Much of the 1969 to 1973 decrease seems to have occurred among birds breeding on ledges on the cliffs. In 1969, the population comprised

FIG. 7. Aerial view of Funk Island, Newfoundland, showing the total island (above) and a close-up of the Gannet colony (below), 19 June 1972.

Table 1

Present Number of Pairs of Gannets in North America, 1972–73

Colony	Number of pairs* 1972	1973
Gulf of St. Lawrence:		
Bonaventure Island	–	17,281
Gullcliff Bay, Anticosti Island	135	–
Bird Rocks, Magdalen Islands		
Great Bird	–	4527
North Bird	–	804
Total	22,747	
Eastern Newfoundland:		
Cape St. Mary's	5260	–
Baccalieu Island	–	673
Funk Island	4051	–
Total	9984	

* Represents the number of "nest-site holders."

8657 cliff-top pairs (nests on flattish ground on top of the cliff) and 11,854 cliff-ledge pairs (nests on ledges on the cliff face), whereas in 1973 there were 8007 and 9274 pairs, respectively.

Gullcliff Bay, Anticosti Island, Quebec.—Counts of birds at this colony indicate a decline in numbers in recent years of approximately 19% (Table 2). At least 200 pairs, and probably up to 250 pairs, bred there in 1963 (Dr. H. Ouellet, pers. comm.; Ouellet 1969). By 1969 there were only 167 pairs, and in 1972 numbers had dropped to 135 pairs.

Bird Rocks, Magdalen Islands, Quebec.—A comparison of the census figures for 1969 and 1973 indicates a relatively stable population (Table 2). The slightly higher number estimate on Great Bird in 1973 does not suggest an increase as a small portion of the cliff (ca. 5% of total) was not photographed in 1969. If the some 170 nests which were likely missed in 1969 are added to the total counted from the photographs (4397 pairs), colony size appears to be very similar (4567 pairs) to the 1973 estimate (4527 pairs).

It is more difficult to assess the results from 1967 as they were collected and analyzed using different procedures. All that can be said is that there may have been a shift of birds from North Bird to Great Bird between 1967 and 1969, perhaps due to cliff erosion. However, it does appear that no recent major changes in numbers of Gannets have occurred at the Bird Rocks.

TABLE 2

ESTIMATES OF GANNETS NESTING IN NORTH AMERICA BETWEEN 1959 AND 1973

Colony	Census date	Number of pairs*	Census method**	Authority
Bonaventure Island	10–13 July 1961	13250	GC-BP	Peakall (1962)
	July 1966	21215	AP-BC-GC	Poulin (1968), J. Poulin & G. Moisan (pers. comm.)
	13 July 1969	20511	AP	J. A. Keith & D. N. Nettleship
	7 July 1973	17281	AP	D. N. Nettleship
Gullcliff Bay, Anticosti Island	9 August 1963	ca.200	BC	Ouellet (1969), & pers. comm.
	13 July 1969	167	AP	J. A. Keith & D. N. Nettleship
	12 June 1972	135	AP	D. N.Nettleship
Bird Rocks, Magdalen Islands				
Great Bird	27 June 1967	3750	AP	R. W. Fyfe
	25 July 1969	4397	AP	D. N. Nettleship & S. M. Teeple
	7 July 1973	4527	AP	D. N. Nettleship
North Bird	27 June 1967	1250	AP	R. W. Fyfe
	25 July 1969	807	AP	D. N. Nettleship & S. M. Teeple
	7 July 1973	804	AP	D. N. Nettleship
Cape St. Mary's	17 July & 17 August 1969	(ca.3000) +	GC	L.M. Tuck & S. Temple
	18 June 1972	5260	AP	D. N. Nettleship
Baccalieu Island	20–21 July 1960	ca.900	BC-GC	L. M. Tuck
	21 July 1969	(351) +	GC	W. J. Learning
	21 June 1973	673	AP	D. N. Nettleship
Funk Island	14 July 1959	2768	GC	L. M. Tuck & J. Fisher
	10 July 1967	2900	GC	L. M. Tuck & H. J. Boyd
	18 July 1969	2786	GC	W. J. Learning
	9 July 1970	2760	GC	L. M. Tuck & R. Long
	11 July 1971	2987	GC	L. M. Tuck & W. J. Learning
	19 June 1972	4051	AP	D. N. Nettleship

* Represents the number of "nest-site holders".
** Census methods: AP = aerial photography, BC = boat count, BP = boat photography, GC = ground count; hyphen indicates combined use of methods.
\+ Count based on incomplete survey (see text).

Cape St. Mary's, Newfoundland.—This colony is not easy to census from a ground location or by boat because neither provides full colony coverage, either separately or when combined. In 1969, the total population was estimated to be about 3000 pairs, though the actual count did not include all parts of the colony (Table 2). However, more important than the reliability of the absolute number estimate is the fact that according to Dr. L. M. Tuck (pers. comm.) numbers of Gannets did not fluctuate significantly between 1959 and 1969.

In 1972 the number of nest-site holders was 5260 pairs. It is impossible to know whether the 1969 estimate was low or the colony has undergone a recent substantial increase, but the available evidence seems to indicate that at least part of the difference is due to a low estimate of occupied nests in 1969.

Baccalieu Island, Newfoundland.—This colony is difficult to census accurately from the ground because only the sloping top of the colony is visible. The view is better from the sea, though the complexity of the cliff face still makes a precise count difficult.

On 20-21 July 1960 Dr. L. M. Tuck (pers. comm.) examined the colony from the land and sea (Table 2), and calculated that there were about 900 occupied nests. In 1969 the population was estimated to be 351 pairs, but it seems quite likely that 2 of the 3 occupied cliff areas that comprise the colony were not examined (W. J. Learning, pers. comm.). From aerial photography, the total count of nests in 1973 was 673.

Funk Island, Newfoundland.—This population is perhaps the best known colony in North America. Counts have been made fairly regularly since its re-establishment was reported by Gilliard (1937), especially from 1951 onwards. While there was a major increase in numbers in the 1950's (see Palmer 1962), the total population did not change appreciably between 1959 and 1971 (Table 2). The nature of the apparent increase in population size from 2987 pairs in 1971 to 4051 pairs in 1972 is hard to assess. If the number difference between the 1971 and 1972 estimates is not real, but due to changes in census technique, there seem 2 main factors capable of explaining the difference: (1) ground counts at Funk Island regularly produced an underestimate of nesting pairs due to the short time period available (usually 4 to 6 hours) to census the colony during any single day visit, and (2) a substantial number of non-breeding birds was included in the analysis of the 1972 aerial photographs. The shortage of time may have limited the completeness of the ground counts in 1967, 1969, and 1971, but any error underestimate is believed to be less than 10% (H. J. Boyd and W. J. Learning, pers. comm.). The absence of ground control data for 1972 prevents an estimation of possible error associated

with the population analysis from photography. However, from tests performed elsewhere (Barrett and Harris 1965), it seems unlikely that the error would be greater than 5%, and probably closer to 2%. Therefore, the interim conclusion is that at least part of the number difference between 1971 and 1972 is real and not due to a change in methodology alone.

CONCLUSIONS

Total numbers of Gannets in the Gulf of St. Lawrence increased rapidly to a peak by 1966, and have since experienced a slight decline (Table 2). Most of the fluctuations in numbers have been due to changes at Bonaventure Island, where the number of pairs breeding increased from 13,250 in 1961 to a known high of 21,215 in 1966, and then declined to a recent low of 17,281 in 1973. Changes in numbers at the other 2 Gulf colonies during the same time period are uncertain, although it appears that since 1969 the Anticosti Island colony has decreased by about 19% while total bird numbers at the Bird Rocks have remained the same; a slight shift of birds from North Bird to Great Bird may have occurred.

Changes in numbers at the Newfoundland colonies are more difficult to assess (Table 2). Qualitative evidence indicates that the Cape St. Mary's population remained somewhat stable between 1959 and 1969, but a precise estimate of numbers was not made. It is impossible to determine if the 1972 estimate is representative of the number of birds present through the 1960's or includes a recent increase. Unlike Cape St. Mary's, the Baccalieu Island colony is believed to have declined since the early 1960's, although the decrease between 1960 and 1969 (900 to 351 pairs) and the subsequent increase (351 to 637 pairs) are likely not to be real, but due to an incomplete count in 1969 (Table 2). Moreover, it is also possible that the population has not fluctuated significantly between 1960 and 1973, the small number difference being merely an artifact of differing census procedures. Funk Island Gannets increased rapidly in the early 1950's (Palmer 1962), reaching a peak in 1959, with no appreciable change in numbers since 1959 and 1971. The colony has apparently increased since 1971, the absolute value of which is unknown.

The reasons for the decreases in the Gulf of St. Lawrence populations are unclear and require further investigation. What is clear, however, is that environmental contamination by toxic chemicals (chlorinated hydrocarbons and heavy metals) is greater in the Gulf than along the Atlantic coast of Newfoundland. In addition, Gannet breeding success is lower in the Gulf (Bonaventure Island) where toxic chemical levels (DDE) in Gannets (mean ppm wet weight brain tissue) are significantly higher than those at Funk Island in Labrador Current waters (Pearce et al. 1973).

Furthermore, egg-shell thinning was detected among Bonaventure Island birds in 1969 to an extent (ca. 17% thinner than pre-1915 eggs) that has been associated with reproductive failure in other birds (Pearce et al. 1973, Keith and Gruchy 1972). This combined with the fact that both colonies which have decreased (Anticosti and Bonaventure) are situated in the Gulf where contamination is most concentrated (i.e., towards St. Lawrence estuary) suggests that toxic chemicals may be the major contributing factor to the observed declines. Less obvious causes such as changes in mackerel numbers and distribution (the main summer food of Gannets in the Gulf) or an increased emigration of Gulf-reared birds to east Newfoundland colonies at time of first breeding may also be operative (see Nettleship 1975).

SUMMARY

The results of 1972 and 1973 surveys indicate a total North American Gannet population of about 32,731 pairs, of which 22,747 (69.5%) nest in the Gulf of St. Lawrence and 9984 (30.5%) on the Atlantic coast of Newfoundland. A considerable decrease in Gannet numbers has taken place at 2 of the 3 colonies (Bonaventure and Gullcliff Bay) in the Gulf since 1969. Reasons for these declines are obscure, though contamination by toxic chemicals seems a likely prime cause. Colonies in Newfoundland appear to have remained somewhat stable (Cape St. Mary's and Baccalieu) or undergone a slight increase (Funk) in recent times.

ACKNOWLEDGMENTS

I am grateful to the following persons for their excellent assistance in collecting the photographic materials necessary for the Gannet project: J. Bouzane (Cape St. Mary's, Funk Island), Dr. A. R. Lock (Anticosti Island, Bonaventure Island, Bird Rocks), and R. D. Montgomerie (Baccalieu Island). Thanks are also due to J. A. Keith and S. M. Teeple for providing me with their Gannet photographs taken in 1969, and Dr. L. M. Tuck for counts of Newfoundland colonies made prior to 1972. My special thanks to M. Channing for his careful analysis of all the 1969, 1972, and 1973 photographs, and to H. J. Boyd and Dr. R. G. B. Brown for their critical review of the manuscript.

This paper is Report No. 25 in the program "Studies on northern seabirds", Canadian Wildlife Service, Environment Canada.

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canadian wildlife service, environment canada, 2721 highway 31, ottawa, ontario, canada. accepted 18 mar. 1975.

REQUEST FOR ASSISTANCE

Black and Turkey Vultures. As part of a study of their ecology, Black and Turkey vultures are being marked with white plastic wing tags. These tags are fastened around the humerus and are visible from above or below. Each tag has a combination of a letter and a 2-digit number painted on it. All birds are being marked in east Mississippi. If marked vultures are observed, please send details of the observation to: Jerome A. Jackson, Department of Zoology, Mississippi State University, Mississippi State, MS 39762.